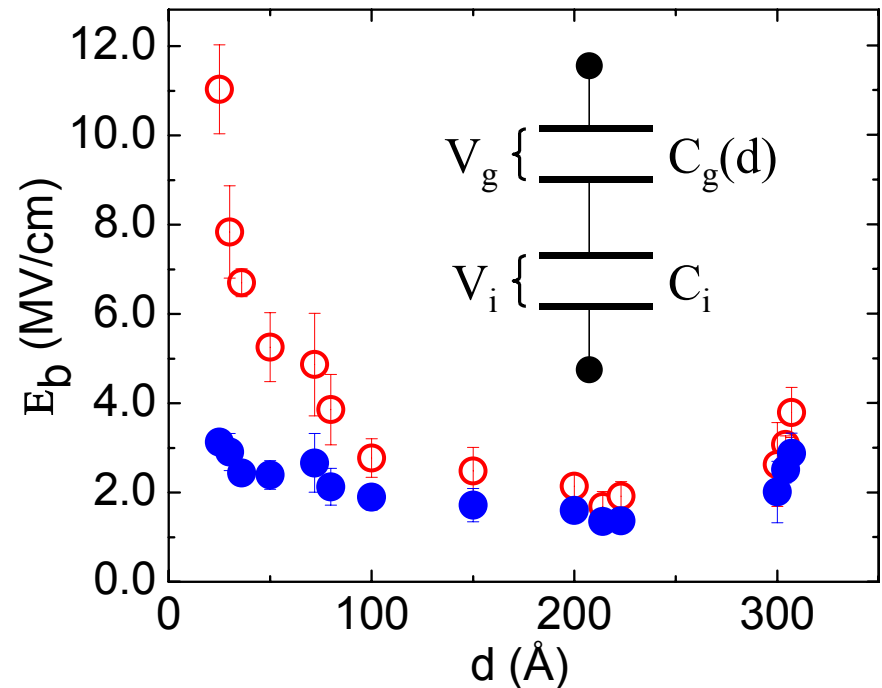


# Contribution of Interface Capacitance to Electric Field Breakdown in Thin-Film Capacitors

Arthur F. Hebard, University of Florida, DMR-0101856

Thin-film dielectrics are used extensively in the capacitors and transistors of modern-day electronics. An important figure of merit is the electric field that the dielectric can withstand before irreversible breakdown. We have found that the standard procedure of dividing the measured breakdown voltage by the dielectric thickness  $d$  gives an overestimate of the breakdown strength  $E_b$ . This overestimate can be corrected by making a capacitance measurement, which takes account of the voltage drop across the interface capacitance  $C_i$  connected in series with the geometrical bulk capacitance  $C_g$  (see Fig. 1 inset) [1]. Our measurements show that the true breakdown strength is independent of dielectric thickness (solid blue circles) over the range 30-300 Å.



**Figure 1:** Plot of electric field breakdown as a function of dielectric thickness  $d$  for Al-AlOx-Al thin-film capacitors showing overestimated values (open circles) and true values (solid circles).

[1] *Applied Physics Letters* **83**, 2417-20 (2003).

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## Education and Outreach:

This project was completed by an undergraduate, Guneeta Singh-Bhalla, with the help of a graduate student, Xu Du. Guneeta assumed full responsibility for acquiring the data and writing the first draft of the published manuscript. Undergraduates have a chance to learn about the PI's work through "word of mouth", bulletin board presentations, and/or regularly scheduled "Meet the Faculty" days (see figure). This grant has supported four graduate students, one part time postdoctoral associate and two undergraduates. Two students have graduated with PhDs. One has a position as a research staff member at Intel, and the second has a postdoctoral position at MIT.



The PI in his laboratory explaining to a group of undergraduate physics majors the research supported by this grant. Undergraduates are able to learn about research opportunities through regularly scheduled "Meet the Faculty" days.